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# Causes of Railway Accidents in India and New Proposals as Preventive Measures

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***Abstract— One of the largest transportation networks in India is railway which conveys almost 22 million passengers every day. The main advantage of this mode of transportation is railway as it is a traffic-free mode of transportation having relatively less cost than other modes of transportations. As the network of railways is so vast, many train accidents have been occurred in past few years. The reasons behind most of the train accidents are mainly two types, i.e. one is technical error and another is human error. This paper enlists some of the major accidents that happened over since 1890 to 2016. After analyzing the several causes of accidents occurred in the past some new design proposals have been proposed as preventive measures such as vertical signal system; use of detonators; ultrasonic pulse generator; automatic Bee-Buzz etc.***

***Keywords— Train Accidents, Causes of Accidents, Preventive Measures, Vertical Signal System, Ultrasonic Pulse Generator; Automatic Bee-Buzz.***

## I. INTRODUCTION

India is a growing third world country where railways are an integral part of the transport system. The low average economy of India requires a functioning railway system to facilitate long travels and economic transactions. Indian Railway system is the largest of its kind in the world and requires immense management, maintenance and construction capabilities to keep it running state. Almost 70% of Indian population in one way or other is dependent on the railways for their daily chores. However now and then the smooth functioning of the Indian railways is disturbed by the accidents caused due to unforeseen reasons which maybe natural or manmade. Such circumstances cause a huge loss of life and damage to property as well as hamper the country's progress. In order to control such accidents one needs to carefully study the reports of such unwanted events and deduce the reasons. This paper enlists some of the major accidents that happened over since 1890 to 2016. The causes of these accidents have been carefully analyzed and best suitable and economic methods have been suggested to minimize these accidents.

## II. PREVIOUS CASE HISTORIES OF MAJOR RAILWAY ACCIDENTS

The data has been collected from documents related to train accidents of Railway Board, Govt. of India and news about railway accidents from several printed media.

*5th November, 1890*: 11 passengers were killed along with 34 injured in a major derailment near Nagpur, Maharashtra.

*24th October, 1907*: A collision of a passenger train & a goods train, near Kot Lakhpat station, near Lahore, in Punjab (before partition) resulted in 22 death and 24 injuries.

*17th July, 1937*: The Sealdah-Patna express drove into the river embankment near Bihta station, 24 kms from Patna resulting 119 deaths and 184 injuries.

*15th September 1954*: A train thrashed a pull car carrying students near a crossing in north of New Delhi. 10 students were killed and 18 students were severely injured in this incident.

*20th October, 1961*: The Ranchi:Kolkata express got derailed 200km apart from Kolkata resulting 47 deaths and injuries of many.

*22th July, 1962*: The Punjab express which is of Howrah bound struck into a freight train at Dumraon station, resulting in more than 100 deaths.

*23rd December, 1964*: The Rameswaram cyclone washed away the Pamban–Dhanuskodi passenger, killing over 126 passengers on board.

*13th June, 1966*: Two passenger trains collided near Matunga, near Mumbai (previously Bombay), killing 57 people and injuring 100.

*14th July, 1969*: A train ran into a stationary passenger train at Jaipur, Rajasthan resulting in 85 deaths and 130 injuries.

*30th May, 1977*: A railway bridge carrying a moving train over the Beki river near Guwahati collapsed, causing 45 deaths and 100 injuries.

*6th June, 1981*: A train derailment occurred in Bihar when it was crossing the Bagmati river bridge and fell into the river, taking more than 300 lives.

*15th September, 1984*: The Jabalpur:Gondia passenger mishap occurred when it sunk in the river near Charegaon, Madhya Pradesh, causing more than 150 deaths.

*8th July, 1987*: The derailment of the Delhi–Dakshin Express at Macherial, Andhra Pradesh, taking 53 lives.

*18th April, 1988*: A train derailment near Lalitpur, 100kms away from Jhansi, causing 75 deaths.

*8th July,1988*: The Island Express (Bangalore-Trivandam Central) derailed on the Peruman bridge and fell into Ashtamudi Lake, causing 105 deaths and 200 injuries.

*16th April, 1990*: The 'Patna rail disaster' which involved fire on the train, near Patna, killing 70.

*21th September, 1993*: A Kota–Bina passenger train collided with a freight train near Chhabra in Rajasthan, causing 71 deaths.

*20thAugust, 1995*: The Purushottam Express collided with the stationary Kalindi Express near Firozabad, north UP, killing 400.

*14th September, 1997*: Several bogies of the Ahmedabad–Howrah Express fell into the river in Bilaspur, Madhya Pradesh, and killing 81.

*6th January, 1998*: The Bareilly–Varanasi passenger collided with the Kashi Vishwanath Express approximately 12 km away from Hardoi, UP killing 70.

*26th November, 1998*: The Jammu Tawai–Sealdah Express ran into three derailed coaches of the Frontier Golden Temple Mail at Khanna, Punjab killing over 212 people.

*2nd January, 1999*: The Brahmaputra Mail collided into the stationary Avadh Assam Express near Gaisal, 310kms from Guwahati, killing at least 285 and injuring more than 300.

*22th June, 2001*: The 'Kadalundi train derailment' which involved four carriages' derailment and falling into the Kadalundi river, of the Mangalore–Chennai Mail, while it was crossing the bridge over the river, killing 52 and injuring 300.

*13th May, 2002*: The Jaunpur train crash took place as sabotage derailed the Shramjeevi Express at Jaunpur, UP, killing 12 and injuring 80.

*9th September, 2002*: The Rafiganj train wreck occurred when the Rajdhani Express, from Howrah, derailed on a bridge between Gaya and Dehri stations, with two coaches falling into the river, killing more than 140. Terrorist sabotage was proved to be the reason for it.

*9th October, 2005*: The Valigonda train wreck of Andhra Pradesh, occurred due to derailing of the Delta Fast Passenger over a small rail bridge, which had been swept away by a flash flood, killing at least 114 and injuring over 200.

*11th July, 2006*: The Mumbai train bombings, a series of coordinated bomb attacks on regular passenger trains, killing at least 200 and injuring more than 700.

*18th February, 2007*: The Delhi—Lahore Samjhauta Express got sabotaged by terrorists, killing 68 boarders.

*2nd January, 2010*: The series of three accidents took place in UP due to dense fog conditions.

i. The Lichchavi Express collided with the stationary Magadh Express near Etawah, 270 km away of Lucknow, injuring 10 people.

ii. Two trains, Gorakhdham Express and Prayagraj Express collided at Panki station in Kanpur, causing 10 fatalities and 51 injuries.

iii. The Saryu Express hit a tractor trolley at an unmanned level crossing in Pratapgarh. No injuries were recorded.

*28th May, 2010*: The Gyaneshwari Express was at first derailed by an explosion and second, struck by an oncoming freight train between Khemashuli and Sardiha stations, about 135kms away from Kolkata, which resulted in killing of 140 boarders and 200 injuries.

*10th July, 2011*: The Kalka Mail got derailed at Fatehpur in UP, resulting in more than 70 fatalities and 300 injuries.

*31st July, 2011*: The Kaziranga express connecting Guwahati and Bangalore got derailed and then was struck by another train coming in opposite direction in district Malda of West Bengal. This resulted more than 200 injuries and 3 fatalities.

*11th January, 2012*: The Brahmaputra Mail connecting Dibrugarh and old Delhi got derailed and then struck a stationary goods train. 5 persons were killed and 9 were injured in this incident.

*31st May, 2012*: THE Doon express got derailed in Jaunpur which resulted in more than 7 deaths and 15 injuries.

*2nd November, 2013*: The Alappuza : Dhanbad express struck into the passengers of Vijaywada: Royagada passenger train resulting 10 deaths and 20 injuries.

*13th November, 2013*: A passenger train hit a heard of elephants near Chapramari wildlife sanctuary in WB. 7 elephants were killed and many more were injured.

*25th June, 2014*: The Dibrugarh Rajdhani express got derailed at Chapra in Bihar resulting 4 deaths and 8 injuries.

*6th December, 2016*: The Rajendra nagar :Guwahati Capital express got derailed in Alipurduar district of WB resulting 2 deaths and 6 injuries.

*21st January, 2017*: The Kuneru train derailment occurred when the Jagdalpur–Bhubaneswar Hirakhand Express derailed near Kuneru, Vizianagaram, killing 41 and injuring 68.

*7th March, 2017* – The 2017 Bhopal–Ujjain Passenger train bombing occurred when a bomb exploded on the Bhopal–Ujjain Passenger at Jabri railway station, injuring 10. This was the first strike in India by the Islamic State.

*30th March, 2017*: Eight coaches of Mahakaushal Express derailed near Uttar Pradesh's Kulpahar, injuring 52.

*9th April, 2017*: Engine of a goods train derailed between Madpur and Jakpur in Kharagpur section of WB. No casualties or injuries were reported.

*15th April, 2017*: The Meerut Lucknow passenger derailment near Rampur, which is 200kms away from New Delhi, caused 24 injuries.

*19th August, 2017*: The Kalinga Utkal express (between Puri and Haridwar) derailed in Khatauli, UP, causing 23 deaths.

## III. ANALYSIS OF THE REASONS BEHIND THE ACCIDENTS

Indian railway has suffered from numerous accidents and there are lots of reasons associated with it.

### 3.1 DERAILMENTS:

After studying the past incidents it has been observed that 60% of the accidents occurred due to the derailments and resulting casualties. Standing committee of Indian Railway has observed that derailment occurs due to the defects in railway track.

### 3.2 UNMANNED LEVEL CROSSING:

About 33% railway accidents happen due to unmanned level crossing and it is one of the major problems in the rural areas of India.

### 3.3 USES OF OLD PENDAL CLIPS:

For some case it is observed that during the visit of higher authorities the railway engineers use the old pendal clips in opposite direction as if it seems new. This type of negligence often leads to severe accidents.

**3.4 NEGLIGENCE OF RAILWAY STAFFS**:

Sometimes poor maintenance, shortcut techniques, carelessness of workers, negligence to the safety rules causes major accidents in railway tracks.

**3.5 TECHNICAL ERRORS**:

Uses of backdated technologies in railway operations causes signalling errors and it causes numerous number of accidents as per as the history of Indian railway accidents suggests.

**3.6 FOG**:

Dense fog creates obstruction in clear vision and hence causes accidents in many region of India.

**3.7 UNDER INVESTMENTS**:

Low investment in every year in the union budget leads to negligence in poor maintenance and bad workmanship. This causes accidents in every year.

**3.8 TERRORIST ATTACKS**:

Terrorist attacks, though not very common in Indian Railway accidents, but is one of the reasons for the same. They have caused more than 100 deaths over the last 7 years.

**3.9 OTHERS**:

Sometimes animals like elephants, rhinos are the reason for accidents in Indian railway. Apart from that overcrowding, human unawareness, selfie addiction etc. cause several accidents. As per as a recent update ,60% of the rail accidents has occurred due to the quest of taking selfies in the railway track of the passengers in Sealdah division which is a part of South-Eastern Railway division.

## IV. PROPOSED PREVENTIVE MEASURES TO AVOID RAILWAY ACCIDENTS

Some common and economic preventive measures have been suggested which can be easily applied in Indian railway.

**4.1. POSITIVE TRAIN CONTROL (PTC):**

Technology that, among other functions, automatically slows down a train if it's travelling above the speed it should be. Designed to prevent train-to-train collisions; derailments caused by excessive speed; unauthorized incursions by trains onto sections of track where maintenance activities are taking place; and the movement of a train through a track switch left in the wrong position.

**4.2 ELIMINATION OF LEVEL CROSSINGS:**

When cars, cyclists and pedestrians have to cross the tracks, there is always a risk involved – a train can't just stop. The best way to avoid accidents on level crossings is to eliminate the physical intersection between the track and the road. ***Level crossings should be replaced with bridges, tunnels, parallel roads or cycle paths***, wherever possible.

**4.3 AUTOMATIC TRAIN PROTECTION (ATP) SIGNALING SYSTEM:**

Automatic Train Protection system is a control system used by railroads to help avoid collisions by automatically controlling the maximum allowable speed (MAS) that a train can travel at in at any given time relative to its movement authority. The MAS can vary from 0 KMPH to the track's MAS, and is determined by variable factors such as presence of maintenance crews on Right of Way (ROW), train headways and the relative distance between the train and home signals. Constant communications between train on-board computer, wayside instrumentation and the control centre help determine MAS.

**4.3.1 Intermittent automatic train control system:**

The intermittent automatic train control system can be integrated into existing signalling systems. Its modular design allows an optimum configuration for every line. It places no specific requirements on the signalling system in order for the railways to be protected, and it supports the driver with a host of automatic functions such as: Continuous and reliable monitoring of speed and braking; Display of target and actual speed in the driver's cab; Acoustic alarm if the target speed is exceeded and automatic triggering of the brakes.

#### 4.3.2 Continuous automatic train control system:

Continuous automatic train control system is a high-performance system for automatic train protection (ATP) and automatic train operation (ATO). It optimizes both punctuality and headways. In addition, it saves work for the driver, who can focus more on passenger safety.

It is a modular system especially suited for metros up to 160 km/h and light rail transits that need to increase traffic volume on existing lines with short headways. The equipment, for example, enables the present driving instructions to be displayed continuously in the driver's cab and allows continuous monitoring of the train speed. Light signals can be dispensed with.

### 4.4 TRACK INSPECTION TECHNOLOGY:

Track measurement vehicles provide precise laser measurements of track geometry, including surface, cross-level, elevation, alignment, and gage. Each mile of highly travelled main line track should be tested about minimum six time in a year. Hy-rail vehicles equipped with the same laser measurement systems found on track geometry cars, for use in confined areas such as yards, sidings and industry tracks, are good enough for the purpose.

### 4.5 RAIL DEFECT DETECTION:

Rail defect detection program uses advanced rail measurements and prediction models to identify and prevent rail defects that can result from metal fatigue due to rolling equipment. The models include a number of factors that influence defect rates, such as rail conditions, wheel loads, annual and accumulated tonnage. As defect rates change, the system automatically adjusts test frequencies to prevent service failures.

### 4.6 CONDITION OF THE RAILWAY TRACK:

It should be properly housed through pendal clip in the concrete (PSC/PRC) sleepers. There should not be any crack for which proper and periodic maintenance required.

### 4.7 AUTOMATIC SIGNALLING:

Normally this signal is LIT green when the track on which the train is supposed to travel is clear and safe for the train the signal LITs green. Other three aspect of this signal is yellow, double yellow, Red. In yellow and double Yellow aspect of the signal the train will proceed with a restricted speed. But in Red aspect the train will not proceed.

### 4.8 USE OF HEAVY RAILWAY TRACK:

Presently authority of Indian railway has decided to introduce railway track by 65kg (i.e., 1 m track weighs is 65kg). It is introduced for accommodating running of high speed train safely. This railway track has another advantage of wider flange so modern railway engine which have got wider wheel flange can run safely through it.

### 4.9 USE OF NEW PENDAL CLIP:

Railways have decided to change the design of the Pendal clip to achieve more gripping between sleeper and railway track. It has more strength high ductility and it needs less maintenance. It will result additional safety to the railway track also.

### 4.10 NEW LEVEL CROSSING GATE:

If we change the design of the dash of the level crossing gate and make it like a cage then after falling the dash of the level crossing gate no person can move under through it. So it will prevent more accident in level crossing area.

## V. NEW DESIGN PROPOSALS AS PREVENTIVE MEASURES

### 5.1 Solution for fog problem

#### 5.1.1. Use of vertical signal system:

Fog being heavy settles down towards the land and obstructs the view of the driver up to a certain vertical limit. Along with the existing railway signal system if another system is introduced say a halogen type light that will focus the signal beyond fogs obstruction limit towards vertical, the signal can be seen by the loco driver easily and from far. This light will flare out the signal towards the sky to a great height so that the signal can be apprehended by the driver from a large distance. The signal will consist of a switch to turn of the system when it is not needed. A diverging lens fixed at the mouth of the conical shell will ensures that the signal flares out over a wide range.

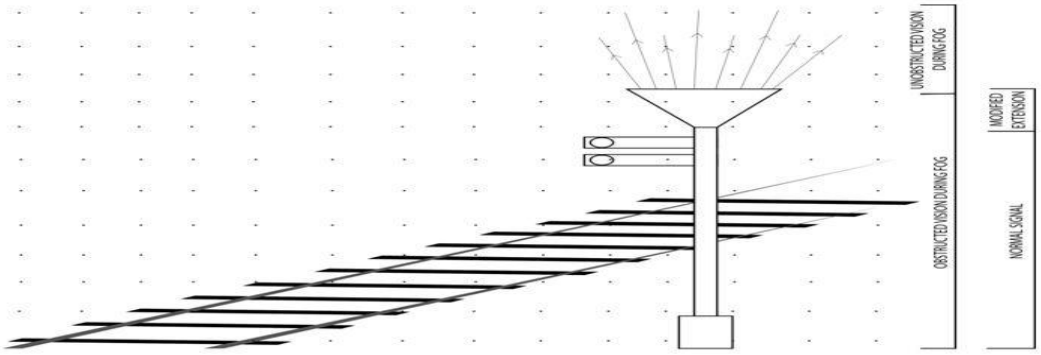


*Fig 1: Modified signal system to prevent accidents due to fog*

**5.1.2. Use of detonators:**

In foggy weather condition when the signal is not visible properly to the driver, detonators can be used to warn. When the signal turns red and the system shows an approaching train, detonators are manually fixed on the track. These no destructive property and produce high intensity sound on bursting. When the train moves over these detonators, pressure of the wheel activates them and they burst to produce loud sound. This sound alerts the driver that the next signal is red and driver slows down the train.

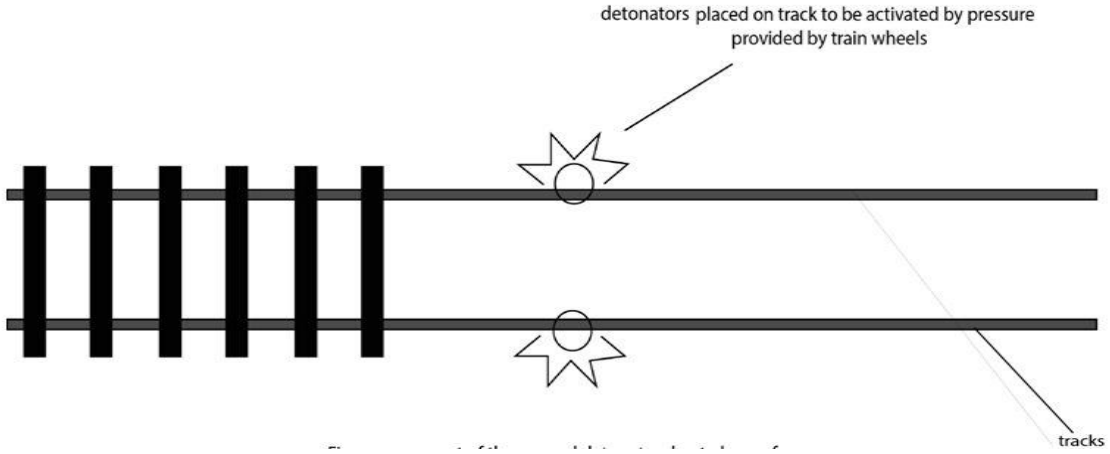


*Fig 2: Arrangement of manual detonator due to heavy fog*

**5.2 Solution to restrict accidents caused due to derailment at a bend.**

Most of the accidents that happen at a railway track bend are due to over speed, due to which the wheels of the coach leave the track. To minimize this ultrasonic sound system can be introduced. The mechanism will be like this: An activator will be fixed on the track just at the start off the critical distance from the bend. This activator will be activated by the vibration caused by the approaching train which in-turn will focus an ultrasonic pulse on the device fixed on the lower part of the engine of the incoming train. This device will consist of an ultrasonic pulse generator cum receiver which on being activated will send two pulses towards certain point on the railway track at a fixed angle. Then they will receive the reflected pulse from the track and the arc length made by these two pulses on the track will be calculated. This arc length will vary along with the radius of the curve and on being compared with the speed of the train will give the idea whether the speed is in limit or not. If the speed is too much a warning will be sent to the driver, who will control the speed within the critical distance before the bend.

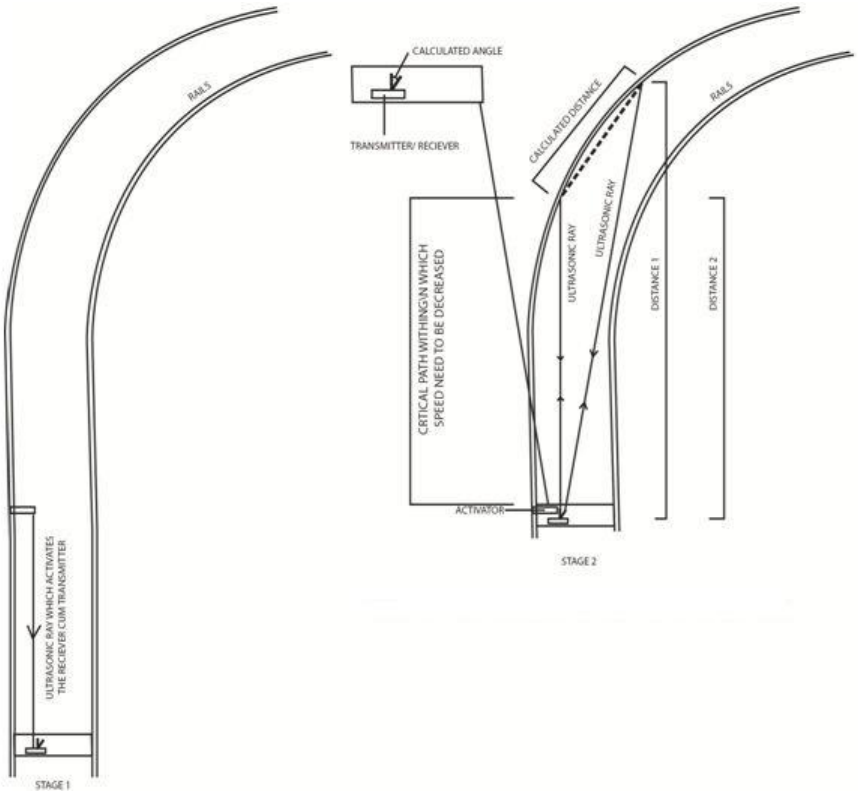


*Fig 3: Use of ultrasound to calculate the critical speed for crossing at railway bends*

**5.3 Solution to keep animals away from track**

**5.3.1. Ultrasonic Pulse Generator:**

Ultrasonic sounds cannot be perceived by humans while most of the animals react and respond to it. This property of ultrasonic can be used to keep the animals away from danger. An Ultrasonic Pulse Generator will be fixed on the cow-catcher of the train engine, which will constantly generate Ultrasonic Pulses at a calculated frequency. When a train comes close to the animal corridor the driver will switch on the device, the pulse generated by the device will warn the animals of the incoming train that will then have the time to move away from the track. Once train crosses the animal corridor the driver switches off the device.

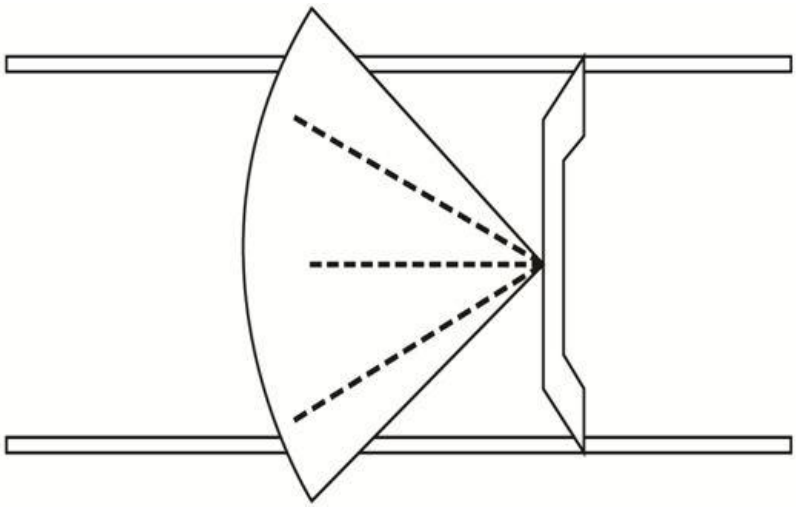

*Fig 4: Use of ultrasonic sound to warn animals on track of incoming train*

**5.3.2. Automatic Bee-Buzz:**

Bees are known to fiercely protect its hive from enemies and are easily recognized by its deep humming sound by all jungle dwelling creatures. This sound induces fear in all animals and can be used as warning system. Sensor will be installed on the track at a critical distance from the animal corridor. When the train approaches, the vibration will activate the sensor, which will activate the buzzers placed beside the track at regular intervals within the animal corridor. The buzzers will generate bee buzzing sounds. Most animals are afraid of the bee buzzing sounds and hence they will move away from the track on hearing it. Thus the track will be safe for the movement of the train. As the sound is a part of nature it wouldn't harm the natural ecosystem neither will it cause irritation to the human beings.

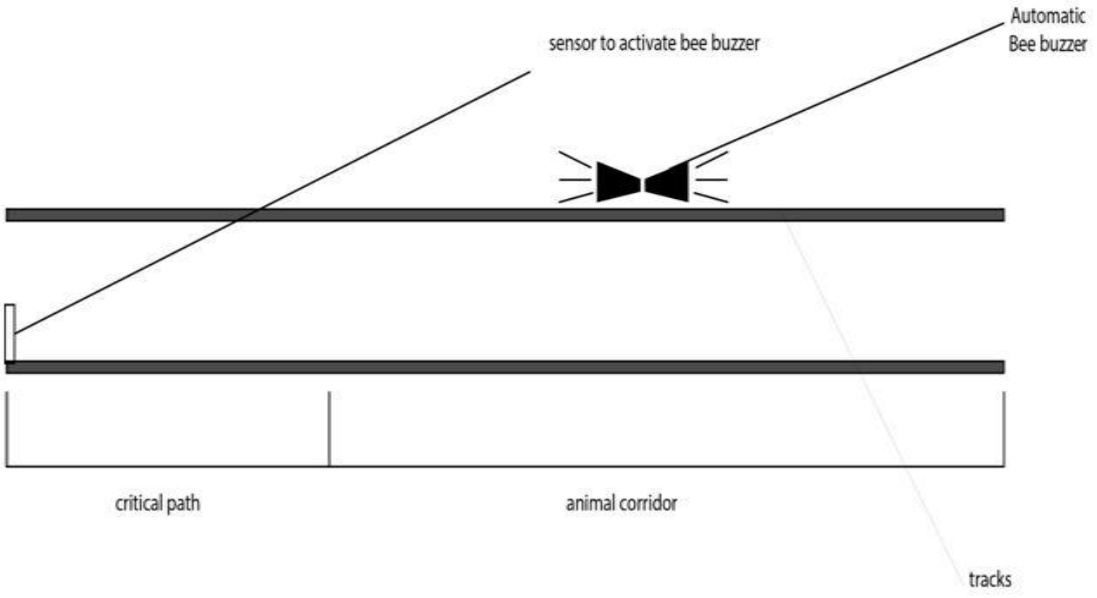


*Fig 5: Arrangement of bee buzzing speaker*

## VI. CONCLUSION

In this paper a huge numbers of critical and massive railway accidents which happened from 1890 to 2017 have been enlisted. A detail analysis of these reasons behind those accidents has been analyzed and some easy to applicable preventive measures in Indian railway have been provided. Also a few numbers of innovative and newly designed technologies have been proposed in this paper which has not been introduced yet practically in India. These technologies are not only effective to reduce railway accidents but they are economic also.

But at the end unless and until awareness among public would be spread by the Indian railway authorities, the fatalities cannot be decreased in remarkable numbers. These awareness program might be like this to aware the people about not to travel on footboard, strict restriction about getting down or entering in the running train, prevention about crossing of manned and unmanned level crossings, posters and advertisements in the media etc.

The railway authority must introduce proper safety engineering, awareness and training to the pilots, guards, and other railway staff before sending them to the on field duty. Attentive surveillance, proper communication with railway police stations to other police stations, shifting of slum areas nearer to railway tracks, high quality maintenance and strict law enforcement must be introduced by the authority of Indian railway to reduce such fatalities.

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